Dr R. Bell
Ottawa

THE

Mineral Resources of Newfoundland,

BY

JAMES P. HOWLEY, F.G.S.

1892.

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1892.

"EVENING TELEGRAM" PRINT, ST. JOHN'S, N.F.

MINERAL RESOURCES OF NEWFOUNDLAND.

BY JAMES P. HOWLEY, F.G.S.,

DIRECTOR OF THE GEOLOGICAL SURVEY.

ST. JOHN'S, N.F., May, 1892.

As a mineral producing country, Newfoundland has only sprung into notoriety within the past quarter of a century. Previous to that date, in fact, from its very earliest history, there appears to have been a vague suspicion of its containing rich mineral treasures, for we find that Sir Humprey Gilbert, who took possession of the island in the name of Queen Elizabeth, in 1583, had with him a mining expert, a native of Saxony, whom Sir Humphrey despatched upon a mining exploration along the coast. He is said to have gathered many specimens of ore, supposed to be rich in copper, iron, lead, silver, &c. To quote from the narrative of the voyage: "One Daniel, a native of Saxony, a very expert miner and assayer, brought to the General a piece of ore, of which he said that he would stake his life that it contained a considerable quantity of silver."

Sir Humphrey was greatly elated at the prospect of rich mineral wealth in his newly-acquired possession; but fearing least the numerous Basque and Portuguese fishermen present should get wind of the

find, he ordered all the specimens to be concealed on board ship till they were again at sea, when he would cause assays to be made. "So confident was he of the value of this ore, that he boasted to his friends that on the credit of the mine, he did not doubt of obtaining from Queen Elizabeth the loan of ten thousand pounds to defray the expense of another similar enterprise."*

But the mines of the waters laving the shores of Newfoundland, which were pronounced by Sir Francis Bacon, in 1610, to contain "richer treasure than all the mines of Mexico and Peru," and whose inexhaustible stores of wealth continues to this day as productive as ever, soon completely eclipsed all other enterprises, and obliterated even the very recollection of the island's more problematical mineral resources. A few desultory attempts at mining were, however, made from time to time, where indications of various minerals presented themselves in the sea cliffs. The most noted of these was at a place called Shoal Bay, twelve miles south of St. John's, where a copper mine was opened up more than a century since, or about 1778. What the result was, cannot now be ascertained, but I believe operations ceased owing to the scarcity of the ore. It was, however, re-opened by Captain Sir James Pearl, R.N., in 1839, and worked for a short time. No records of the shipments, if any, are extant. Quite recently I have seen very good specimens of grey copper ore from this same locality.

Other attempts at mining of much more recent date were made at various points on the Peninsula of

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*The poor mining expert, with most of the crew, and all his precious ores, was afterwards lost in the *Delight*, one of Sir Humphrey's ships, on Sable Island.

Avalon upon small veins, both of copper and galena, but in most cases they were attended with but poor success. The ores, especially those of copper, were usually of a very rich quality, being chiefly variegated, such as erubescite, bornite, covelline, &c., and generally contained in quartz veins, but sometimes in broken killas rock, filling small cracks or fissures. The galena, also, frequently occurred in quartz, but more usually in calcareous spar; the La Manche lead mine, Placentia Bay, being a good example.

In 1864, the present Geological Survey of the Island was established, coincident with the opening up of the Union Copper Mine, Tilt Cove. The labors of the one, and success of the other, soon created a lively interest in mining enterprises, which at one time reached to fever heat, and then again gradually subsided. At the present time, mining has settled down to a sober, steady industry, slowly but surely advancing in importance with the growth of the country, and increase of our knowledge of its resources, It is not at all chimerical to look forward to a time when mining and the manufacture of metals, &c., will rank second to no other industrial pursuit in this island.

As a preliminary to entering more into detail of the various mineral substances now known to exist in the Island, I presume a short general description of its principal geological features will not be out of place.

The appellation of "Terra Nova," or New Land, given to this Island by the early navigators is one of the most ridiculous misnomers conceivable—at least, in a geological sense. It is in reality a very old land, and had an existence, in large part as dry land, when

but one small rock in the North-east corner of Great Britain represented that island. The 42,200 square miles comprising the total area of Newfoundland, are made up chiefly of the oldest known geological formations, beginning with the Laurentian and ending with the Carboniferous. Not one of the higher or more recent Mesozoic systems, known to geologists, have any existence here, always excepting the superficial drift, chiefly made up of glacial debris, river-silt and ordinary clays, derived from disintegration of the rock surfaces. Much vegetable matter, in the form of peat, is found to occupy a large portion of the surface, especially over the less wooded areas of the interior.

The great Laurentian system, so largely developed in Canada and on the Labrador, occupies a very extensive portion of Newfoundland. The southern coast line of the island, from Bay d'Espoir to Cape Ray, presents one bold front, 150 miles in extent, consisting of granites, syenites, mica, schists, &c., all referable to this period. They extend inland for many miles, and then branching out from the base into several great tongues, stretch across the island, forming the chief elevated ridges of the interior. One of those tongues or belts, commencing at the head of Fortune Bay, strikes in a northeasterly direction and comes out to the shore again on the north side of Bonavista Bay, forming most of the coast line between the latter and Gander Bay, in the great bay of Notre Dame. It also constitutes nearly all the numerous outlying islands, rocks and reefs, lying off this portion of the coast. The Funk Islands, a group of small granitic rocks, forty miles from the land, form the extreme north-east outlyer of this tongue. A

second great ridge of granitoid and gneissoid rocks trending in the same direction strikes away from the base on the westward of Bay d'Espoir, and forms the height of land between the two great valleys of the Gander and Exploits Rivers, narrowing towards the north-east and terminating in a point near the shores of Dildo Reach, Notre Dame Bay. The third and most extensive belt of Laurentian trends away north-easterly from Cape Ray, and passes between the Exploits and Humber Valleys, being split up in the latter valley, where it is overlaid by the central Carboniferous trough of the island. One branch of this latter ridge runs out towards the extremity of the peninsula separating Notre Dame from White Bay, while the other continues northward through the Northern Peninsula, or "Petit Nord" of the French, nearly to the extreme north point of the island. This ridge is termed the Long Range Mountains, and is in reality the backbone of the entire structure of the island. One small isolated patch of the same system forms the nucleus of the Peninsula of Avalon. Surrounding this nucleus on the extreme eastern seaboard, and the shores of Conception and St. Mary's Bays, we have a set of ancient sedimentary strata consisting of:

(*a*) Diorites and quartzites, with jaspery bands.

(*b*) Slate conglomerate.

(*c*) Greenish, purplish, pinkish or red slates, often approaching in hardness jasper or chert. These have sometimes been called feldsite slates, or hornstone.

(*d*) Dark brown or bluish black slates, with thin layers of hard fine grained sandstones toward the top. This has been named the St. John's slate, or

Aspidella slate, from the occurrence in it of an obscure fossil organism peculiar to these rocks in Newfoundland. It has been named *Aspidella Terranovica*. There is also another obscure form *Arenicolites*, which appears to be almost identical with *Arenicolites Spiralis*, a fossil occurring in Sweden in a formation lower than M. Barrande's Primordial.

(*e*) Greenish and greyish, very hard quartzose sandstones or whinrock, in massive beds.

(*f*) Dark red fine grained sandstone, nearly as hard as preceding, passing into a fine conglomerate towards the top.

(*g*) Heavy beds of coarse, reddish, conglomerate or pudding stone.

This formation has been hitherto designated Huronian, from its striking lithological resemblance to a similar series of strata, in about the same horizon, known by that name in Canada. It forms the greater portion of the Peninsula of Avalon, also the two long projections between Trinity and Bonavista, and Placentia and Fortune Bays, while much of the country stretching inland from the heads of these great indentations is underlaid by the same series. In Conception, Placentia, St. Mary's, Trinity and Fortune Bays extensive patches of a more recent and unconformable formation fringe the shores on either side, resting upon both the Laurentian nucleus and the various members of the preceding Huronian. The three islands in the first-named bay, also Random Island in Trinity Bay, and the Island of Langley, off the entrance to Fortune Bay, are occupied by this same formation. Some of its strata, more particularly the slaty and calcarious beds, are crowded with fossil organisms. Red sandstones, conglomerates and quart-

zites predominate at the base. Red, purple and greenish slates, with limestone beds, form the central portion, and towards the top dark colored shales and grey sandstones are the prevailing rocks. The chief organisms are trilobites, near the base, and lingula zoophites and worm tracks, &c., towards the summit. It has been named Primordial Silurian and Lower Cambrian; but the latter name is that by which it is more generally recognized now. Sir William Dawson, K.C.M.G., the great authority on Acadian Geology, considers this series the equivalent of his "Acadian Group," and also of the Longmynd, Menevian, and Lower Lingula flag groups of Britain.

Large tracts of country on the eastern, northern and southern side of the island are occupied by a great variety of metamorphosed rocks, exhibiting a vast amount of disturbance. These rocks are twisted, distorted, upheaved and faulted, penetrated by numerous dykes and masses of intrusive trappean, granitic and other disrupting elements, and have undergone so much change as entirely to lose their original character. Quartzites, diorites, feldsites, porphyries, &c., form a large portion of the mass, while chloritic, talcose and plumbaginous slates and shales are not infrequent. Innumerable quartz, calcareous and other vein rocks, penetrate all alike, running in every conceivable direction, most of them holding some or other metallic substance. That some portion of these metamorphic rocks are referable to either or both the preceding Huronian and Lower Cambrian series, there can be little doubt. Again, in the Bay of Notre Dame, the principal Cuperiferous district of the island, another great set of metamorphosed formations occurs. These are characterised by large patches of steatitic,

serpentinous and dolomitic bands, while felspathic ashes, with a very considerable portion of chloritic slates, diorites, quartzites and red jaspery bands, besides a variety of other more or less altered strata, constitute the bulk of the series. Similar rocks occupy very extensive areas of the Northern Peninsula and the western side of the island, being especially well displayed over the country lying between Bonne Bay and the Bay of Islands, and the latter bay, Port-au-Port and St. George's Bay. Another very extensive tract in the interior, lying between the head waters of the Gander and Bay d'East River, exhibits all the characteristics belonging to the same horizon.* This series of metamorphic deposits has obtained the name of the metalliferous zone of North America, owing to its highly mineralized character throughout its entire range. Here in Newfoundland it has been proven well deserving that title. The great Silurian series of formations are all represented here in greater or less volume. The valleys of the Exploits and Gander Rivers are chiefly underlaid by Lower Silurian slates and sandstones, &c. Middle Silurian organisms are abundant on some of the islands of Notre Dame Bay, and still more so on the Port-au-Port Peninsula, on the western side of the island. Lower, Middle and Upper Silurian strata frequently crop out along the Northern Peninsula, and on the shores of White Bay. In this latter bay, also, occurs the first appearance, so far as yet known, of the succeeding Devonian or Old Red Sandstone series. The two small projections or peninsulas of Cape Fox and Cape Rouge, and a portion of Groais Island, near the north-east

*The Quebec group of Sir William Logan.

extremity of the island, are the only other points at which this latter formation exhibits itself in Newfoundland.

The Carboniferous series occupies two extensive areas of country, one bordering on the West Coast surrounding the Bay of St. George, the other in the valley of the Humber River. As this series is more particularly referred to under the head of Coal, it is needless to enter into any details here.

METALS AND THEIR ORES.

Precious Metals—Gold.

Rumors of the existence of gold in several parts of the island had been long circulated, but up till about ten years since, no *bona fide* find of this noble metal, that could be thoroughly relied upon, came to our knowledge. Previous to that date, traces of gold were detected by analyses in specimens of quartz from Humber Arm, Bay of Islands, and also in an arsenical iron ore from Bonavista Bay. In 1880, some genuine specimens of free gold were discovered in quartz veins in the vicinity of Brigus, Conception Bay. Upon an investigation by the Geological Survey into the geological and mineralogical characteristics of the district, it was found that the quartz usually occurred in small irregular patches, or veins of segregation, cutting bands of hard felsitic slate and whin-rock, near the base of the so-called Huronian, or Lower Cambrian formation. Though a few larger veins of a more persistent character were met with in the same neighborhood, the gold appeared to be confined entirely to the smaller patches of quartz, which reticulated through the hard slate rock. The investigation resulted in the finding of several promising sights of free gold, in the form of small isolated nuggets, frequently deposited in little drusy cavities, surrounded by decomposed feldspar. On removing this soft material, the gold would fall out, being unattached to the quartz. In some cases, however, it was

attached to, or disseminated through, the quarts itself and accompanying chlorite, which frequently composed a large part of the lode rock. It was found, however, on further investigation, that very few of the numerous small veins of quartz contained the gold, and that the body of the rock showed no gold, not even a trace, on being subjected to the usual tests. The veins, or patches of quarts, containing the metal were rarely of any extent, and a few blasts not infrequently resulted in the disappearance of the lode rock. Some considerable prospecting, and an attempt at minfng, by crushing and washing the quartz, was entered upon, but failed in bringing to light any more promising indications. About the same time, gold was discovered in two other localities far removed from eaeh other, and from the former. Some free gold was obtained in quartz veins at Bay of Islands, where it had previously been detected by analysis; but by far the most promising specimens yet discovered, were obtained at a place called Ming's Bight, on the north-east side of the island, situated on the peninsula of land separating Notre Dame Bay from White Bay. The proprietors of the Bett's Cove Copper Mine had commenced mining here on a copper deposit, and when about thirty or forty feet down, came across some thin veins of quartz and bitter spar penetrating the chlorite rock of the lode, which were found to be well charged with gold. I am unable to say what quantity of gold was extracted from this mine, but have been informed that quite sufficient to prove it a rich lead was taken out; at least, one nugget of several ounces in weight was obtained. A specimen now in the Museum is about two inches square. It consists mainly of bitter spar, very much

cleaved and jointed. One side of it has a dull leaden hue, and contains a mineral, supposed to be Tellurium. The gold is profusely distributed through the central part of the specimen in thin plates, surrounding the crystals of dolomite on all sides. It presents the appearance of being electroplated. It is seen to penetrate the cleavages of the stone, often showing through the thin transparent crystals. It also runs into the grey metal on one side, while on the opposite side there are numerous small crystals, of arsenical pyrites or mispickel. No returns have ever been made, either of the quantity of gold or copper yielded by this mine. Work thereon was suspended in a short time, owing, it is said, to some litigation and theinterference of the French ships of war—the mine being sftuated on what has been called the French Shore of Newfoundland, or that portion over which the French nation exercises certain treaty rights. The presence of gold in most of the copper ores of Notre Dame Bay, had been detected by the color of the flame in smelting the ores several years since. More recently, quite an appreciable quantity of the precious metal was ascertained to exist in the low grade ore from the Union Mine, Tilt Cove, and it has lately transpired that gold to the value of £10,000 stg. was extracted from this ore, in the process of refining, during the past twelve months. I am also informed, that free gold in small quantities has been met with in thin quartz veins cutting the lode rock. So promising has this yield proven, that orders have been given the manager of the mine to carefully examine all the refuse slag, &c., in the dumps, with the result that paying quantities of gold have been found therein. Several specimens of mispickel (ansenical pyrites),

from the same bay, have yielded, on analysis, a greater or less percentage of the precions metal. Though the above is sufficient to indicate the actual presence of gold on three sides of the island, it, perhaps, hardly warrants us in calling it an auriferous country. Still, its presence at all, and the fact that the nearest neighboring province—Nova Scotia—has proven eminently auriferous, leads us to hope that, upon further development of this island, and a more systematic search for the precious metal, gold discoveries of more importance may result therefrom. This hope is strengthened by the fact that the Pre-Cambrian, Cambrian and Cambro-Silurian formations, (the same which hold most of the gold of the Globe) are so largely developed here, and in an unusually disturbed, altered and mineralized condition. It has not, I think, been definitely decided as yet whether the Nova Scotian gold-bearing rocks are of Pre-Cambrian (Huronian) or Lower Cambrian age; but it is pretty certain, whichever they may eventually prove to be, their equivalents are to be found on the eastern seaboard of Newfoundland.

Silver.

Many years since, a deposit of galena, in a gangue of greenish and pinkish flourspar, was discovered at a place called Lawn, situated on the extremity of that long, narrow peninsula separating Placentia from Fortune Bays. Mining operations were commenced here by a local company, and under the management of a Cornish mining captain. In following the lode at one point near the shore, they struck a small vaugh or cavity, filled with what appeared to the miners to be a dirty sand or gravel. It was shovelled out and thrown on one side, where it

became washed by the rain-water, when several lumps and strings of dark-colored metal appeared, which proved to be native silver, mixed with other ores unknown to the miners. Specimens were saved and brought to the notice of chemists, who pronounced them to be chloride of silver (horn silver), native silver, and ruby silver, or rather what would appear more to resemble proustite (light red silver ore). As soon as the miners became cognizant of the value of the ore, it is said they appropriated most of it and sold it to jewellers and others of St. John's and St. Pierre. That there is some truth in the latter part of the story, would appear, from the fact that I have been shown specimens in one of those shops, purporting to have come from the locality in question. From some cause I am not sufficiently acquainted with, the mine was abandoned after a short while. It may be that the galena, for which it was worked, proved very sparsely disseminated through the gangue, or the fact that they did not succeed in finding a second vugh containing those rich silver ores. I understand, also, a large portion of the cliff had foundered, completely burying up the workings. All this occurred long before the institution of the present Geological Survey. Shortly after my predecessor, the late Alexander Murray, C.M.G., taking this work in hand, he procured a specimen of this ore from one of the original proprietors of the Lawn Mine and sent it to Canada, where it was analyzed by the then chemist of the Canadian Survey, Dr. T. Sterry Hunt, who pronounced it a sulph-arseniuret of silver (ruby silver?), yieldfng 65.28 per cent. of metal. It was encrusted with chloride of silver (horn silver). A recent attempt was made to re-open this mine, which failed,

as I presume, from want of sufficient capital. Native silver, in thin films or plates, was found encrusting the cleavage planes of a mineralized slate, on the Fortune Bay side of the same peninsula. An attempt was made at mining here, but soon abandoned as unremunerative. Nearly all the galena ores occurring on every side of the island containi a greater or less percentage of silver. One deposit at Little Placentia, in Placentia Bay, yielded specimens showing as high as 356 ozs. to the ton of ore, thus proving it an eminently argentiferous galena. A mine was opened here, known as the Silver Cliff Mine, and worked vigorously for a few years, but subsequently abandonded. The ore did not prove so abundant or rich in silver throughout as the work progressed; but there is reason to believe, from certain facts ascertained, that the true or mother lode of this property was never discovered, and that the small veins actually opened up are but leaders or stringers to a more important deposit. This supposition is borne out by the finding of large blocks of prill ore, several hundred pounds in weight, unearthed amongst the loose gravel near the surface, while costeaning for the lode. No such blocks as these were found in the actual workings.* The same specimens of quartz from Bay of Islands, mentioned as containing traces of gold, also showed a small percentage of silver. None of the other noble metals have yet been detected in the island.

*What appears to he thc main lode has recently been discovered, and specimens from it look very fine and contain a large percentage of ore.

ORDINARY METALS AND METALLIC ORES, &c.

Rutile.

Rutile occurs in large embedded crystals, in a vitrious quartz, at White Bay.

Tin.

1.20 per cent. oxide of tin was found to be contained in a specimen of Columbite, from Labrador. [See Analysis, No. 11].

Molybdenite.

This is a mineral which occurs in many places around the shores of this island and in the interior. Quite a considerable deposit was found, a few years ago, in Fortune Bay; but the demand for the substance being so very limited, no attempt has been made at mining the ore. Good specimens have also been exhibited from Hamilton Inlet, Labrador.

Tellurium. (?)

Already mentioned as occurring with gold, in bitterspar, from Ming's Bight.

Bismuth.

Traces of, in galena, from Little Lawn. [See Analysis, No. 1].

Antimonite (Stibnite).

This mineral occurs at one or two localities, chiefly in the great Bay of Notre Dame. A deposit, which gives promise of developing into a paying mine, occurs at a place called Moreton's Harbor, on New World Island, in that bay. Some desultory mining

has been carried on here, for some years back, with fair prospects. Not having seen the deposit, I cannot speak of it, except from specimens exhibited, which look very favorable. Other specimens were procured on an island called Duck Island, near Badger Bay, Notre Dame Bay. The Customs Returns, appended to this paper, show a small export of this ore during the past two years.

Iron Ores.

Ores of iron are very common in many parts of the island, and comprise nearly all the usual varieties: magnetite, hematite, specular iron ore, limonite, ilmenite, chromite, siderite, vivianite, clay ironstone, brown and yellow ochre, iron pyrites, pyrrhotine, mispickel, &c. Of these, magnetite, hematite, chromite, clay ironstone and pyrites are the most abundant ores. The former occurs in large masses, in the vicinity of some of the copper mines, notably the Union Mine, Tilt Cove. An immense body of magnetite was discovered a few years since in the Laurentian Range, near St. George's Bay, on the West Coast. It was found on analysis, however, to contain a large percentage of titanic acid, which greatly militated against its usefulness. That there is an abundance of a similar ore in the same range, is indicated by the large quantity of debris found in the beds of most of the streams issuing from the Long Range Mountains. Magnetic iron sand is of very common occurrence, both in this island and along the Labrador coast. Hematite occurs with the magnetite at Tilt Cove and elsewhere. Chromite is found, generally, associated with the serpentine group of rock wherever displayed in the island; and there would appear, from the loose debris scattered about, to be a considerable deposit

of this ore in the vicinity of Pipe Stone Pond, on the head of the Bay d'East river. The clay ironstones are confined to the coal measures of Bay St. George and the Grand Lake region. In the latter, extensive beds were come across during the past season (1891), consisting of irregular nodular or lenticular masses, arranged in layers of stratification, with also some solid bands of from two to three feet thick. The common yellow pyrites (mundic) occurs all over the island, and is found, more or less, disseminated through every formation that goes to constitute its rock crust, but its chief value consists in the immense massive deposits associated with the copper ores in Notre Dame Bay and elsewhere. At the Terra Nova Mine, Bay Verte (not at present in operation), Mr. Murray, in 1867, speaks of the deposit as consisting of "an enormous mass of iron pyrites, with an occasional admixture of yellow sulphuret of copper." Again, at the Union Mine, Tilt Cove, a mass of this ore, said to be over 200 feet thick, was driven through a few years since, on the east of the original copper workings. It is very hard and compact, with a close, even texture, and contains, on an average, about two to four per cent. of copper. At the Tilt Cove, Bett's Cove and Little Bay copper mines, large quantities of this same ore have been mined with the copper; probably one-third of the bulk of ore raised, most of which was thrown aside in the dressing. Another immense deposit is now being extensively mined at Pilley's Island, Notre Dame Bay. The lode is said to average sixty feet in width, and contains 52 per cent. of sulphur.* This mine is now in a flourishing con-

* Prof. Holloway has obtained as high as 55 per cent. from some specimens submitted to him for analysis.

dition, employing some hundreds of men, and shipping large quantities of the ore each year to market, principally to the United States, to be used in the manufacture of sulphuric acid, copperas, &c. It has been ascertained, within the past year or two, that the refuse cinder left after the extraction of the sulphur is of a very superior quality for the manufacture of certain classes of Bessemer. The quantity of ore shipped from Pilley's Island mine, as taken from the Customs Returns, will be found in the tabular statement. Quite recently, the enterprising proprietors of this mine have introduced the electric light underground, which enables them to work continuously night and day. This is the first instance in which this light has been employed in miningin Newfoundland.

Columbite.

Obtained from the Labrador coast. [See Analysis, No. 11].

Manganese.

Ores of manganese have been observed in several localities, but, as a rule, not of a rich quality. One massive black oxide comes from the south side of Conception Bay, where quite an extensive deposit occurs as a contact lode. It contains about 51½ per cent. oxide of manganese, the residue being chiefly iron and earthy impurities. Wad, or bog manganese, is a very common ore, found as a surface deposit in many localities. A carbonate of manganese of a pure white color, probably a variety of rhodochrosite of rare occurrence, is found in the heighborhood of St. John's, usually as an incrustation on decomposed slate rock. It appears to be a rare variety, as I do not see it described in any work on mineralogy.

Chrome.

Besides the chromic iron already alluded to, I have seen chromate of lead from the west side of the island. The presence of chromium is also indicated by the frequent stains of green oxyd of chromium, either on the surfaces or impregnating many of the rocks of the magnesian series, especially some of the dolomitic or bitterspar bands.

Nickel.

Nickel has been detected by analysis in several of the serpentine and dolomitic rocks of the island. Quite an extensive deposit, consisting of several varieties of the ore, viz.: copper-nickel, cloanthite, millerite and gersdorffite, were found in a vein of dolomite, or bitterspar, intersecting the chloritic lode rock of the Union Copper Mine at Tilt Cove. Between the years 1869 and 1876, both inclusive, 411 tons of nickel were shipped from Tilt Cove, valued at $32,740. Since that date, no returns of any ore having been shipped are on record.

Cobalt.

Cobalt occurs, sparingly associated with the nickel ore, at Tilt Cove. Cobalt bloom was observed at one or two places, as a stain or incrustation on the rocks.

Zinc.

Ores of zinc, including most of the more common varieties, viz.: blende, zincite, and calamine, occur in several localities, as at Tilt Cove, Placentia and Lawn. Nowhere, however, as yet, has it been found in any considerable quantity, such as to render it worth mining for itself alone. Red oxide of zinc, from the Lawn mine, yielded on analysis, traces of bismuth and cadmium.

Cadmium.

Traces of, in zinc blende, from Little Lawn. [Analysis, No. 5].

Lead.

The ores, of lead, chiefly galena, are disseminated throughout almost every rock formation in the island, generally in quartz and calcspar veins. Numerous small quartz veins containing this ore occur on the Peninsula of Avalon, especially in the Huronian formation. Several attempts at working these ores were made many years ago, but in most instances with but poor success. The most promising and best conducted mine yet opened is situated at a place named La Manche, at the head of Placentia Bay, the property of the Telegraph Land Company, now the Newfoundland and Canadian Trust Company. Operations were commenced here in 1857, and for a time the mine was vigorously worked. It changed hands two or three times. Finally, the work began to languish, and the mine was closed about 1870. Recently, the original owners have re-commenced operations here, and are now getting it in working order. From 1857 to 1868, some 2,375 tons of galena were extracted altogether from excavations, amounting to about 1,000 cubic fathoms, equalling an average of 2.37 tons per cubic fathom. The vein stuff consists chiefly of calcspar, with a mixture of quartz, sulphate of barytes and a little fluorspar. It averages about three feet thick, but often widens out to six or seven feet. It is a regular well-defined lode, filling a fissure in the slate rock. It is in a nearly vertical attitude, and runs very straight, with great persistency, for a long distance. The country rock consists chiefly of a set of greenish, very hard and brittle, compact cherty or

jaspery slates (Division C of Huronian Section), which cleave exactly with the bedding. The vein material is frequently tinged with a pale purplish color, and beautiful amethystine quartz crystals are often found lining the sides of small vugs or cavities in the lode rock. The ore is distributed irregularly through the whole thickness of the vein, in patches and isolated crystals, but there appeared to be a pretty regular and continuous string of ore near the middle, of from one to four or five inches in thickness. Large quantities of what the miners term "prill ore," in blocks of many pounds weight, were found in the vugs and pockets at intervals throughout the workings. The only other lead mine which gave promise of considerable value, was the Silver Cliff Mine, at Little Placentia Sound, already referred to under the head of Silver Ores. Assays of this ore gave over 70 per cent. of metal. A very peculiar deposit of galena occurs in Port-au-Port Bay, on the West Coast. The matrix of the lode consists chiefly of crushed Lower Carboniferous limestone, filled with its characteristic fossil shells in great profusion and well preserved. It would appear to have fallen into a fissure, or rather collapsed, by the undermining and crumbling away of the subjacent Lower Silurian limestone, masses of which, containing its characteristic fossils, are caught up in, and confusedly blended with, the Carboniferous. In the broken, crushed rock, much calcspar occurs, in which the galena is thickly disseminated. An attempt at mining this ore here, which gave much promise, was stopped some eight or ten years since by the interference of the French fishery protection squadron, on the ground that it would clash with their fishing privileges. Numer-

ous other indications of galena are reported, and many specimens of beautiful, clean ore exhibited from this western side of the island, chiefly from Silurian rocks. A pale, yellow chromate of lead has also been exhibited from that side. The oxyd of lead is only found as an incrustation, resulting from decomposition of galena in some of these localities, while I have never yet seen phosphate of lead in the island. Nearly all the galena ores contain more or less silver, and sometimes traces of other metals. Galena also is shown as a product of the Labrador, but merely as specimens, so far as yet known.

Copper.

Perhaps of all the mineral substances known to the island, copper ranks first in point of importance, and certainly does in development. It is, at least, a century since the first attempt at mining this ore was made at a place called Shoal Bay, near St. John's. The ore found was chiefly yellow sulphuret, mixed with a little green carbonate, but the deposit consisted merely of a few small strings and nests of ore, in a very hard sandstone or whin-rock. The work was soon abandoned, as there was not sufficient ore to render it remunerative. Quite recently, some very rich specimens of grey copper, tetrahedrite, have been procured in the same neighborhood. Beautiful rich variegated ores, including several varieties, such as erubescite, or bornite, copper glance, covelline, red copper ore, malachite, &c., have been found in a great many places, especially in the Peninsula of Avalon, and several attempts to mine these richer ores were made from time to time, attended with varying success. Generally, the hard intractable nature of the enclosing rock, and the character of the vein material

—usually quartz—rendered the extraction of the ores difficult and expensive. The discovery of the deposit at Tilt Cove, in Notre Dame Bay, in 1857, since named the Union Mine, gave a new impetus to copper mining in the country, though mining operations were not actually prosecuted there till 1864. The deposit consisted chiefly of yellow sulphuret of copper and iron, averaging about 12 per cent. of copper, though it has reached as high as 30 per cent. Tilt Cove soon sprung into notoriety from the enormous deposit of ore laid bare in the various openings. The Mine Bluff, as it was termed, or real lode rock, consisted chiefly of a compact chlorite slate, very ferruginous, containing thin seams and threads of serpentine, and having enclosed huge intercalated masses of hard, compact, gray and greenish crystalline rock, probably dolomite. This rock is slightly calcareous, and weathering on the surface a pale yellowish color. The lower part of the lode rock is chiefly of a soft steatitic character, which occasionally contains masses of serpentine and soap-stone, magnetic iron being disseminated through it in grains and crystals. Overlying, and in front of the mineralized band, is a mass of hard gray diorite, or trap, probably intrusive, containing epidote in strings and patches, and scattered through it are minute crystals of bitter-spar. A great body of serpentine succeeds this rock on the north. Underlying the lode the rocks consists chiefly of diorites, black and dark green slates, quartzites, bands of red jasper, and jaspery iron ore, patches of dolomite and serpentine, all confusedly jumbled up together, still preserving a rude arrangement resembling layers of stratification. Such is the general character of the country in the immediate vicinity of

Tilt Cove—a description of which will apply generally to all the other localities in the Bay of Notre Dame, where copper has been mined. In almost all cases the lode rock is more or less chloritic, and diorites are present, either in the lode or over and underlying it; but in some instances the steatitic and serpentinous strata are not present, except, perhaps, as mere threads and strings, or in small patches.

The Union mine continued in active operations up to a few years since, when the decline in copper took place, and a change of ownership caused the working to languish for a while. It is now in the hands of an energetic mining company,* who are pushing on the work vigorously, and have raised a large quantity of ore during the past year. The mine is situate on the north side of Notre Dame Bay, about ten miles from Cape St. John, which forms the extreme north point of the great bay.

In 1875 the Bett's Cove mine was opened. It lays further in the bay, on the same side; distant from the former eight miles. This mine was worked with extraordinary activity for ten years, during which period 130,682 tons of ore and regulus were exported therefrom, besides 2,450 tons of iron pyrites. The ore, as at Tilt Cove, occurs in a mass of mixed chloritic slate and diorite. In the course of the excavating some enormous pockets of ore were come across. Work was suspended on this mine about 1885, owing to the great depreciation in value of copper, and from the caving in of the mine-bluff—a great boss of mineralized rock capping the mine—which had been completely honey-combed by the excavations. It is

*The Cape Copper Mining and Smelting Company.

thought the ore was far from being exhausted at the time. Several other copper mines were opened up during this period, and more or less ore derived from each. The principal localities which gave most promise were Burton's Pond, the Colchester mine, S. W. Arm, Shoal Arm, Little Bay, Lady's Pond, Whale's Back, Hall's Bay, Sunday Cove Island, Rabbitt's Arm, and Thimble Tickle, Seal Bay—all within the great bay of Notre Dame. But the most celebrated of all the copper mines yet developed in this region is the Little Bay mine, which has been in constant and active operation since 1878, though it has, during that period, changed its ownership. Operations were only commenced here in August of the above year, yet, before the end of the season, some 10,000 tons of ore were raised and shipped to Swansea. Between 1880 and 1885, 61,796 tons were shipped from this mine, and since that date to the end of last year, over 40,000 tons of ore, regulus and ingots of copper are given in the Customs Returns. Between 1880 and 1882, the South-West Arm mines yielded 490 tons; Hall's Bay, 240 tons, while Rabbitt's Arm mine—which was only worked for one year—yielded 1,260 tons of ore, averaging 28 per cent. copper. This latter mine forms rather an exception to the others. While chloritic slate is the prevailing rock, containing strings and nests of ore, with at least one solid band, most of the copper was derived from a set of large parallel bands of quartz, varying from three to five feet wide, richly impregnated with ore of a higher percentage than ordinary. Grey copper, containing a considerable percentage of silver, is sometimes associated with the other ores in this mine. At Lady Pond mine the ore is a rich yellow sulphuret, with a

large proportion of beautiful purple and bluish erubescite, generally occurring in pockets. Some of the copper deposits in this bay, notably those of Sunday Cove Island, consist of wide bands of fine, soft, shelley chloritic slate, impregnated with iron and copper pyrites, and containing bands of yellow copper ore, varying from mere strings to layers of several inches thick. Here, also, very beautiful arborescent filaments, of native copper are found on the cleavage plains of the lode rock. Metallic copper occurs at the Union Mine, Tilt Cove, in thin sheets or plates, lining the walls of cracks or slips in the lode rock. It has been found on the west side of the island, in Port-au-Port and Bay of Islands. In the latter instance it forms strings, nests and small pockets, scattered through an amygdaloidal trap, but more especially confined to small veins of bitterspar, intersecting the same rock. The other localities where ores of copper have been found are too numerous to mention. It will be sufficient to state that the indications of these ores occur on all sides of the island, and in every one of the great bays at hundreds of localities. During the past six months a new discovery of copper has been made at South-West Arm, Green Bay, near the old Colchester mine. This lode is said to average six or seven feet wide, with two feet of solid ore.

Labrador—of which we know but little mineralogically—is, in all probability, a cuperiferous region also; many rich specimens of copper ores have been brought from various parts of the coast, and a mine was actually worked there, at Black Island, several years ago, with what success I am not in a position to say.

EARTHY MINERALS.

Coal.

There are two distinct carboniferous basins in this island—on its western side. The first is known as the St. George's Bay trough. It occupies a fringe of the south side of that bay, about sixty-eight miles long by tweleve wide, comprising an area of about 816 square miles. Other small outlying patches on the north side of the same bay, and again in Port-au-Port Bay, would probably bring the total area up to 900 square miles. The second, called the central carboniferous trough, is situated in the valley of the Humber River, which flows into the Bay of Islands, at the head of the Humber Arm. Although laying in a direct line from each other, and corresponding with the general trend of the physical features of the country, the two areas are separated by between sixty and seventy miles of distance, though they were at one time probably connected. The central basin comprises a superficial area of about 500 square miles. By far the greater portion of both basins is occupied by the lower and unproductive portions of the series, especially the carboniferous limestone and millstone-grit formations. The entire southern side of St.

George's Bay exhibits the above strata, frequently broken by faults, and repeated again and again. One great anticlinal fold running parallel with the shore, extends up and down the coast, with a westerly dip on the outside, towards the waters of the Gulf of St. Lawrence, and an opposite dip inland, where the strata which hold the coast are repeated, and at a distance of some six or seven miles from the shore, the middle or true coal measures are exposed on the snrface. A long, narrow trough, of some three or four miles wide, is here brought in, which holds several fairly good seams of coal. The lower measures come again to the surface on the inner side of the trough, where they finally rest against the Laurentian Mountain Range in the rear. What the longitudinal extent of this coal trough may be, has not yet been definitely ascertained, and it can only be determined with certainty by the use of the boring-rod. Coal was known to exist in this region for a long time; but the difficulty of exploring it thoroughly, and the large display of the lower formations, barren of coal, on the coast, seemed to convey the general impression that no coal of any consequence existed here. In 1889 a more thorough investigation by the officers of the Geological Survey, resulted in the finding of several seams of good coal, which were uncovered at their outcrops, and traced for some distance, so as to obtain accurate and reliable measurements, and good average specimens of the quality of the mineral. Referring to the report of that year, it shows that, altogether, fourteen seams of coal, of a varying thickness, from a few inches up to six feet, were uncovered on one small brook; three seams on another, two miles distant, and four small seams on a third brook,

still further eastward some two and a half miles. Of these, the following are the best and most promising:

	Average thickness of coal.	
	ft.	*in.*
Juke's seam	4,	6.
Cleary seam	2,	2.
18-inch seam	1,	6.
Slaty seam	1,	4.
Clay seam	1,	8.
Rocky seam	1,	5.
Murray seam	5,	4.
Howley seam	4,	2.
Shears seam	1,	2.

These, with some smaller ones, aggregate a thickness of twenty-seven feet of coal in the section, which is repeated by being brought again to the surface on the other side of the synclinal trough. There is reason to believe that these do not represent all the seams in this section.

In the central carboniferous trough, which was the object of special investigation last season, several seams of coal were found in the region of the Grand Lake, occupying another long, narrow, synclinal trough. Two sections cross this trough, and at two miles distant from each other on the strike, were measured, with the result that, in the first one, sixteen outcrops of coal were observed, and in the second, twenty-eight outcrops. These are not separate and distinct seams, but the same seams repeated by the doubling up of the strata. So sharp is this trough in one case, that twenty-four of those outcrops are crowded into a horizontal distance of 600 feet. None of the seams are large; only a few averaging three feet of coal each. Many of the smaller seams of good coal are so close together, being divided only by five or six feet of

loose, shaly strata, and all in vertical position—that I believe several of these could be worked as one seam by a single drift along the strike. All the coal as yet discovered in this island is of the soft bituminous variety; some of it approaches cannel coal. One seam in St. George's Bay, "the Shear's seam," has a very clear, shining black lustre, and hardness approaching the softer kind of anthracite. A few tests of the Bay St. George coal have been made, showing a good average coal; but, up to the present time, the result of specimens sent home from Grand Lake is not known.* Neither of these coal areas have been thoroughly explored, as yet; and the difficulty of carrying out a close investigation, where so much of the surface is covered with loose debris, renders the use of the boring-rod absolutely necessary to further prove the character and extent of these coal deposits.

Graphite (Plumbago.†)

Graphitic, or plumbaginous slates and shales, are common to several formations, particularly the Cambrian and Cambro-Silurian. Impure deposits of plumbaginous clay, or pulverized slate, filling fissures, frequently occur in these rocks, and the material has been used by the inhabitants in the neighborhood as stove polish. Much purer specimens of graphite come from the Laurentian formations, on the south side of the island, and in the Long Range Mountains.

Bitumen, Petroleum, &c.

A small piece of black, hard, glistening bitumen, apparently identical with the New Brunswick Albert-

*The analyses of these were received since the publication of this paper, and some of them proved fairly good, considering they were only surface specimens.

†Plumbago should more properly come under the head of Refractory Materials.

ite, was found in the gravel in Bay St. George, near the Murray coal seam. Bituminous shales and limestones occur both in the Lower Silurian, or Cambrian, and Lower Carboniferous formations, on the western side of the island. In Port-au-Port Bay, and at Parsons' Pond, Sandy Bay, crude petroleum is frequently found floating on the surface of the water, and collected in little cavities in the rocks. An attempt to bore for oil was at one time made near Cow Head, West Coast, but was unsuccessful—it is supposed from not having pierced the true oil bearing strata. The bituminous shales in the Lower Carboniferous series on the Humber River, after being exposed to sufficient heat, ignite and burn freely, with a yellow flame, giving off a strong smell of petroleum. Shining black crystalline bitumen, resembling jet, occurs in small quantities, in amygdaloidal trap rock, in Port-au-Port Bay.

Salt and Brine Springs.

Brine springs are quite common in the vicinity of the gypsiferous deposits of the Carboniferous series in St. George's Bay, and the rocks are frequently found coated with deposits of fine white salt. It is not at all improbable that these indicate here, as elsewhere in the same series, underlying beds or masses of rock salt.

Mineral Fertilizers.

Limestones suitable for the manufacture of lime are abundant in many parts of the island. Shell marls occur in a few places in St. George's Bay. While gypsum is one of the most extensive and abundant products of the Carboniferous formation in the same region. Besides its use as a fertilizer, much of this gypsum is of the snow white variety, admir-

ably adapted for stucco-work. Only last season was the first attempt made to work and ship to market this crude material. An American Company, which uses large quantities of the finer qualities of gypsum, for such purposes as dressing the surfaces of writing paper—giving it a fine white gloss—and the adulteration of flour in the manufacture of confectionery, &c. where only the very purest snow-white gypsum would be applicable, have leased one of the gigantic masses which appear near the shore, and are working it vigorously since then. Veins of beautiful selenite—alabaster—frequently penetrate the masses of gypsum, and in Codroy Valley considerable qnantities of it are found. The presence of phosphate of lime, Apatite, has as yet only been recognized as mere specimens; there is good reason to suspect its occurrence in more pronounced deposits, amongst the Laurentian series of formations, so extensively distributed in this island. Specimens indicating its presence on the Labrador, are to be seen in the Museum.

Mineral Pigments.

Barite, both white and of a pink shade, is a pretty abundant mineral, being found accompanying other vein stuff in many of the localities where galena and zinc occur. It also occurs in distinct veins free from other minerals, but usually discolored. Large blocks of pure white sulphate of baryta come from Labrador. Earthy materials, such as yellow, red, brown and various other shades of ochres, are abundant throughout the lower carboniferous deposits. These, mixed with oil, make fairly good substitutes for paints, and are often used by the inhabitants. Red ochres, resulting from the decomposition of iron ores, are met with on every side of the island; and it is this material

the aboriginal inhabitants (The Red Indians of Newfoundland), made such extensive use of, and from which they derived their appellation. Not only their persons and clothing, but every implement, weapon, culinary utensil, or ornament they possessed, was smeared with a mixture of oil or grease and ochre, *odemet* as they termed it. Besides the red and brownish clays and marls, I have frequently seen very fine clays of bluish and drab colors, which would, I have no doubt, make excellent pigments. Whiting could easily be obtained from the deposits of shell marl mentioned above. I have seen a deposit of fine white gypsum in a plastic state, which, when taken out and moulded, then dried in the sun, become quite hard. This material should, I think, be very applicable for whitewashing or liming purposes.

Refractory Materials.

Graphite and plumbago have already been mentioned. Very pure steatite, talc, soapstone, and other varieties of rocks, suitable for furnace lining, are abundant. Good specimens of these are to be seen at the Museum here, as also ground steatite, applicable as a lubricant. No *bona fide* attempts at working any of these materials have yet been made. Mica is quite a common mineral throughout the Laurentian Series, but nowhere in Newfoundland, so far as I am aware, has it yet been come across in plates large enough to be of much economic importance. It is, however, known to occur in abundance, and in large sheets, on the Newfoundland portion of Labrador; good specimens of which are in our Museum. Steatite, also, comes from the same region, and a very good variety of potstone. Asbestos, or chrysotile, deserves special mention, as it is likely to prove of very con-

siderable economic importance ere long. This mineral has been recognized amongst the serpentine deposits of the island in many localities. It occurs in strings and threads of fine silky texture, traversing the masses of serpentine in all directions. Not until quite recently, however, was the attention of capitalists called to its existence here, and fairly enlisted in its development. The comparative scarcity of good material in America, and the not distant prospect of the Canadian deposits of this valuable material giving out, led to the large manufacturing firms of Chalmers, Spence & Co., of Boston, and the John's Company, of New York, in sending persons to prospect in this country. Certain properties known to contain asbestos, in the vicinity of Port-au-port and Bay of Islands, were leased by them, and operations commenced by costeaning the surface, laying bare the deposits, and running open cuts into the side of the serpentine ridge. A good deal of excellent fibre was obtained thereby, though the deposit is exceedingly irregular. The fibre varies from less than half to about five inches in length, averaging about two inches. So far as quality goes, it is, I believe, all that is requisite for ordinary use. Other parties opened up deposits of serpentine nearer the shore, showing abundance of short fibre, in numerous small veins. Some of this is two to two and a half inches long, and is of a beautiful fine and silky texture, approaching amianthus in purity. It is believed the coming season will witness great activety in exploration for this mineral substance, as its greatly enhanced value of late years, and its comparative scarcity in the market, render it an object much sought after. Serpentines and their associated rocks, identical in character with those holding the material

in Canada, occur abundantly in many parts of Newfoundland, which is already regarded in Canada as, in all probability, "Quebec's greatest rival" in the near future, in the production of this valuable commodity. Other varieties of this mineral, not considered just now of any commercial value, are found accompanying the former, such as actinolite, tremolite, pyroxene, horn-blende, &c. Fire clays are abundant in the coal measures, both as distinct deposits and forming the floors of many of the coal seams. Their adaptability to the manufacture of fire-brick has not yet been tested. But a small specimen sent to the copper smelting works at Little Bay, has just been pronounced of excellent quality.

Materials for Grinding and Polishing.

Abundance of material exists in many parts of the island, admirably adapted for all purposes of grinding and polishing. Good whetstones for edged tools may be procured from the Huronian slates, near St. John's, and in many parts of the Peninsula of Avalon, also among the talcose slates of Placentia Bay. Admirable scythe stones are procurable amongst the mica schists, while the Carboniferous series would afford an unlimited supply, as well as grindstones, of any degree of coarseness or fineness. Infusorial earths, and earthy marls, which would probably answer the purpose of tripolite for polishing, are not rare. Staurotide and coarse garnets are so abundant as to be available when pulverized, as a substitute for emery powder. Quartz is abundant all over the island. A very fine white silicious sand is found on some parts of the Labrador coast, well adapted for the manufacture of sand-paper. I believe it would also be suitable for the manufacture of glass.

Building and Ornamental Materials.

An infinite variety and abundance of admirable building stones, &c., is to be found all over the island. Granites, syenites, porphyries, of every shade of color and consistency, abound. Sandstones, from hard whin-rock to freestones, range from the Huronian to to the Carboniferous formations, the latter, in particular, affording an abundance of the softer sandstones and grits. Limestones, capable of being used in the rough, or as marbles when cut and polished, exist in great profusion. Immense deposits of pure white and mottled statuary marbles range from the mouth of the Humber River northward, towards White Bay, and are again met with in Canada Bay. Amongst these are beautifully veined, pale, pinkish, bluish, drab, yellowish and some black varieties, all of which take a high polish. Beautiful specimens of serpentine, mottled dark and light green, from the neighborhood of Tilt Cove, are to be seen in the Museum at St. John's. But serpentine is by no means confined to this locality; there are large areas occupied by similar rocks on the Northern Peninsula, on the western side of the island and in the interior. Many of dolomite bands accompanying the serpentines present a variety of colors, rendering them very beautiful and applicable to ornamental or monumental purposes. A dark red variety, veined and spotted with white bitterspar from the interior, greatly resembles the "Rosso di Levante" of Genoa. The hard grey and reddish whinrock of the Huronian formation, known locally as the Signal-hill sandstone, is much used in St. John's for building purposes. The Episcopal Cathedral of St. John the Baptist and St. Patrick's Church, afford good examples of it. But the principal

use it is put to is for the foundation of houses, bridge abutments, retaining walls, &c. The rock is not easily cut, but can be readily dressed into blocks of any size or shape by the hammer, while the numerous cleavage planes afford, frequently, two or more sides perfectly shaped, as though from the chisel. The same material, or debris from it, is also much used, when crushed small, for laying the street and road beds of the city. Even the worn oval beach stones, derived from this source, are brought into requisition in large quantity for paving the surface drains, and as borderings for ornamental flower-beds in gardens, &c.

The Government House at St. John's, a handsome building, is chiefly constructed of the red sandstone, or whinrock, from Signal hill, as are also many of the old fortifications near the entrance to the harbor of St. John's, all derived from the neighboring hills. The rock generally, but especially the greenish grey variety, is of so untractable a nature that the action of the weather seems to have no appreciable effect whatever upon it; while, on the other hand, imported stones, especially limestones and soft sandstones, do not stand our climate at all well. The Roman Catholic Cathedral of St. John the Baptist is chiefly constructed of a sandstone from Kelley's Island, in Conception Bay, belonging to the succeeding Cambrian formation. It is a good rock, but not so durable as the former. One of the Convents at St. John's is built of a pale flesh red syenite from Conception Bay, and is a very handsome structure. A grey close-grained granite, from Rose Blanche, on the southern side of the island, has been used to some extent in the construction of Lighthouses. It is a durable and excellent building material.

Slates of superior quality occur in nearly every formation, but by far the best yet produced are derived from the Lower Cambrian of Smith's Sound, in Trinity Bay, and also from Paradise Sound, Placentia Bay.

Quarries were opened at the former locality several years ago, and a considerable number of slates shipped to the United States, Canada, and elsewhere, besides supplying the local market of St. John's and Harbor Grace. The slate is generally of a dark purplish color, but sometimes light bluish green. It cleaves readily in slabs of any thickness desired, and is pronounced by the Welsh quarrymen of the place, in every respect, equal to the Carnarvon slate (being probably in almost the identical same Geological horizon). The limited local demand, and substitution of so many other roofing materials, rendered the quarrying of this slate non-remunerative, and at present nothing is being done towards utilizing it. Flagstones of every variety may be had in abundance, in almost any district of the Island. The slates above mentioned can be dressed to any thickness desired, and would, if planed, be admirably adapted for bedding of billiard tables, &c.

Under this head may also be included limestone, for burning into lime, which is in abundance. The lime produced from the Topsail Head limestone, Lower Cambrian, and manufactured on the spot, is said to possess superior qualities as a good lime for masonry.

As there are many dolomitic and magnesian limestones scattered throughout the metamorphic and Lower Silurian formations, there is every reason to believe that good hydraulic lime can also be reckoned

upon. As no attempt has ever been made to test these latter, I cannot speak with certainty.

Under the head of building materials may also be reckoned brick-clays. Clays of several varieties are abundant; the most common being a nearly white or pale drab colored, very plastic clay, apparently suitable for brick making, and for the coarser kinds of pottery. They usually underlie the peat bogs, and are termed by the people, pipe-clays. Immense deposits of it are found on some of the river valleys, notably the Exploits River. A dull brownish drab stratified clay, derived from Lower Cambrian rocks in Smith's Sound, Trinity Bay, has been utilized for brick-making for a long time, and seems well adapted to that purpose. Overlying the Carboniferous Series, in Bay St. George District, extensive deposits of fine clay, ranging in color from pale drab to bright red, may be found almost anywhere. These latter are surface deposits, and distinct from the regularly, stratified fire-clays of the coal measures, though some of them may prove equally valuable as such.

Kaolin clay is known to exist as a result of the decomposition of feldspar, chiefly in the granitoid districts. A considerable deposit of it occurs in Bonavista Bay, and is believed to be of excellent quality. It received some attention a few years since, but I presume the demand was not sufficient to call for any great outlay upon the deposit; at all events, it has been abandoned for some time past.

MINERAL SUBSTANCES APPLICABLE TO THE FINE ARTS AND ORNAMENTAL PURSOSES.

Lithographic Stones.

Although as yet no specimens have been submitted to any test for this purpose, there are, nevertheless, amongst the Silurian limestones of Port-au-Port, and the Lower Carboniferous of St. George's and Humber Valley, many fine, close-grained compact beds, which would give the impression, from a superficial examination, of being suitable for such a purpose. Those of the Carboniferous Series are usually thin bedded, cleaving into slabs of various dimensions. Their color is pale drab, and the texture exceedingly fine and close, apparently free from crystals of calcite or other coarse material which would render them unfit for such a purpose. Red, brown and yellowish jaspers are abundant, capable of taking a high polish, and often of deep rich colors, adapting them to the purposes of jewellery. Pebbles of many materials, and much beauty and variety of color, can be procured in some localities. Some of the greenish banded flourspar from Laun is very pretty, also banded amethystine quartz. Beautiful amethystine crystals were found lining the vugs in the La Manche lead vein. In this mine was also found a good opal. Rock crystal, chalcedony, agate, &c., are common. Opalescent quartz, in the form of loose bowlders, occurs in some localities on the surface. Several large pieces were met with last year on the Humber Valley. Labradorite is very common in the Laurentian series; some specimens showing these brilliant

chatoyant reflections in great perfection. The most beautiful specimens, however, come from the Labrador coast. Garnets, usually coarse and dull, are very profusely distributed through some of the mica schists, and gneissoid rocks. A few, showing very considerable depth of color, have been met with. Some very minute garnets, of a clear transparent lustre and fine color, were seen at Bay d'Espoir. Jet black tourmalines are common. Mr. Milne, M.E., mentions having seen rubelite on the southern coast. Beryl, of a pale green color, but too dull to be of use in jewellery, has been met with sparingly.

Other Mineral Substances.

There are many such not enumerated above, as of little economic value at present, and which, consequently, have received little or no attention. I have seen a brecciated conglomerate, filled with various colored pebbles, in a dark greenish matrix, holding many blood-red jaspers. It attracted my attention as resembling very much the beautiful rock forming the supporting pillars of the Dome of the Capitol at Washington. The variety of ornamental building stones in the country can never be known or appreciated until the demand for them calls for more attention being directed to their utilization. The absence of many important groups of minerals from the above list does not necessarily indicate their non-existence. Hitherto, all the attention of explorers, has been directed to the more valuable metallic deposits, the earthy minerals being all but ignored; no systematic collection by a mineralogist, for purely scientific purposes, has ever been attempted. I have little hesitation, however, in expressing the opinion that most of the metallic ores, not yet enumerated,

will, in course of time, be added to our list. While very many of the more common non-metallic substances are almost certain to occur. I base this opinion on purely geological grounds. First, from the fact that the rock formations of the island are the same which comprise the chief mineral bearing zones of our globe; secondly, that they are in an unusually disturbed, shattered, altered, metamorphosed and highly mineralized condition, eminently indicative of the presence of metalliferous deposits.

The possession of so many useful minerals and economic substances in this island (the oldest and nearest British American possession to Europe), should, I imagine, point to Newfoundland as a country most favorably situated for mining and manufacturing industries, second, indeed, to none of the other British American possessions. The construction of main lines of railway through the island, now being vigorously pushed forward, must, in the near future, result in bringing about a greater activity in this direction. Already (though the immediate coast line only is accessible to mining capitalists), Newfoundland ranks as one of the chief copper producing countries of the globe. Yet, even this industry may be said to be merely in its infancy. Though possessing coal and iron deposits of undoubted value, not one ton of either has yet been mined for market, while our own importation of the former most necessary material, amounts to fully 10,000 tons per annum, and is rapidly on the increase. The local market alone should prove a sufficient incentive to making the mining of coal a promising investment. The softer varieties of coal, those princfpally used here, stand the consumers on an average of $4.50 per ton, while they frequently range as high as $6.00 or $7.00.

LICENSES TO SEARCH FOR MINES, GRANTS IN FEE, &c.

A great advantage in the way of mining in this country is the fact that so little of its area is occupied or held in exclusive possession as yet. The lumbering licenses though extensive give no claim either to the surface soil or the mineral contents which may occur beneath. The same applies to agricultural grants. Mining licenses only, which are held for one year and can be renewed twice for a similar period, on payment of an extra fee, are exclusive as regards minerals during their continuance. They are limited to one square mile of area. A mining lease or grant, with fifty acres of surface free for mining plant and erections, &c., can be obtained upon payment of a further fee and fulfilment of certain conditions as regards working and expenditure thereon, extending over a period of five years, but the owner can at any time during that period obtain his grant in fee on giving satisfactory proof of having complied with the conditions and having expended the required sum in working the mine, &c.

The accompanying tabulated statement of minerals taken from the Customs' returns, will, I have no doubt, prove of interest in connection with this paper. These returns are not, however, by any means as complete as they might have been, and both the quantity of ore shipped and value thereof are much underestimated. Even for last year I find that while but 19,150 tons of pyrites are set down in the table

of exports, in reality some 30,000 tons were shipped from the Pilley's Island mine. Again, between 1865 and 1867 but 38½ tons of copper are returned as exported. I learn from other sources that in reality it amounted to 6,580 tons. There is no return at all for 1868, yet several large cargoes of copper were shipped during that year from Tilt Cove.

Quantity and Value of Minerals Exported from Returns, as Published in Journals of

Years.	Copper Ore, tons.	Regulus, tons.	Ingots, tons.	Value of Ore, in dollars.	Value of Regulus and Ingots in dols.	Total value Copper Ores, &c., in dols.	Nickel Ores, tons.
1854 to 1864	627½	.....	.....	$ 22,980	.....	$ 22,980	....
1865	236	.....	.....	8,496	.....	8,496	....
1866	283½	.....	.....	10,206	.....	10,206	....
1867	79	.....	.....	2,370	.....	2,370	....
1868	None....	.....	.....	.....	.....	.....	....
1869	3,422	.....	.....	100,504	(?).....	109,504	2½
1870	5,226	.....	.....	167,232	.....	167,232	38
1871	1,407	.....	.....	45,024	.....	45,024	7
1872	4,955	.....	.....	588,560	.....r.	588,560	8
1873	5,553	.....	.....	194,355	.....	194,355	120?
1874	5,052	.....	.....	121,248	.....	121,248	98
1875	10,018	.....	.....	370,666	.....	370,666	17½
1876	25,134	.....	.....	614,700	.....	614,700	28
1877	47,454	.....	.....	1,264,004	.....	1,264,004	....
1878	35,823	750	.....	788,106	34,500	822,606	....
1879	28,405	1,112½	.....	511,290	44,500	555,790	....
1880	22,042	21	.....	440,840	840	441,680	....
1881	27,351	.....	.....	547,020	.....	547,020	....
1882	19,004	260	.....	456,096	12,480	468,576	....
1883	11,989	353	.....	239,780	16,944	256,724	....
1884	4,079	385	.....	73,422	25,795	99,217	....
1885	4,401	300	.....	88,020	14,400	102,420	....
1886	235	6,678	24½	3,760	242,390	246,150	....
1887	7,491½	.....	120-10	119,864	49,000	168,864	....
1888	3,322	1,290	1,205¾	66,440	749,946	816,386	....
1889	2,306	761	1,343	46,120	310,250	356,370	....
1890	400	1,236	609	3,400	223,392	226,792	....
1891	7,060	3,626	1,139	63,540	502,510	565,850	....
	283,355½	16,772½	4,441-10	6,967,043	2,226,747	9,193,790	319

Newfoundland to end of 1891, taken from Customs House of Assembly. J. P. Howley, 1892.

Value of Nickle Ore in dollars.	Lead Ores — tons, cwts.	Value of Lead Ores in dollars.	Iron Pyrites Ores, tons.	Value of Iron Pyrites in dollars.	Other Minerals and Ores, tons.	Value in dollars.	Total values of Ores, &c., exported.
$		$		$		$	$
.....	.....	.....	.....	.....	.....	1,240	112,980
.....	2,?50.0?	90,000	.....	.....	slate 31,000	.....	24,772
.....	313.5	15,036	.....	.....	.....	.....	10,446
.....	5.0	240	.....	.....	do., tons 50	600	2,970
.....	4	8	.....	.....	do., tons 101,000	2,020	2,028
600	2	4	.....	.....	.....	.....	110,104
9,120	.....	.....	.....	.....	.....	.....	176,352
700	.....	.....	.....	.....	.....	.....	45,720
2,560	.....	.....	.....	.....	.....	....	591,120
3,600	.....	.....	.....	.....	.....	.....	197,955
4,704	.....	.....	.....	.....	do. 6,000	120	132,312
5,520	130.0	6,240	.....	.....	do. 6,000	120	378,865
2,800	95.0	4,560	.....	.....	.....	.....	619,324
.....	38.0	1,824	.....	.....	.....	.....	1,265,396
.....	10.0	1,392	.....	.....	.....	.....	822,706
.....	2.0	100	.....	.....	.....	.....	555,790
.....	.....	.....	.....	.....	.....	.....	441,680
.....	.....	.....	.....	.....	.....	.....	547,020
.....	.....	.....	.....	.....	.....	.....	468,576
.....	.....	.....	10?	72	.....	.....	256,796
.....	.....	.....	950?	7,600	.....	.....	106,817
.....	.....	.....	.....	.....	.....	.....	102,420
.....	.....	.....	.....	.....	.....	.....	246,150
.....	10.0	400	410	8,200	mica, lbs. 12	240	117,304
.....	.....	.....	1,850	37,000	.....	.. ..	853,686
.....	.....	.....	7,530	64,000	.....	.....	420,370
.....	.....	.....	8,670	72,315	antimony	1,200	300,307
.....	.....	.....	19,150	57,900	do	1,000	624,750
29,604	2,853.11	119,804	38,570	247,087	slates 114,000	6,540	9,594,717

ANALYSES.

No. 1. GALENA, LITTLE LAWN.
Sulphuret of Lead P. b. S.
Analysis.....Lead and Sulphur.
Copper—nil.
Silver—nil.
Bismuth—traces.
Cryst.=I. Cleavage on cube H=2·5 Sp. G.=7·2.
By RICHARD COLB'T HENNESSEY.

No. 2. GALENA, LAWN.
Sulphuret of Lead P. b. S.
Analysis.....Lead and Sulphur.
Copper—nil.
Silver—nil.
Cadmium—traces.
Cryst.=I. Cleavage on cube H=2·5 Sp. G.=7·2.
Gangue Fluorspar.
By R. C. HENNESSEY.

No. 3. GALENA BAY D'ESPOIR.
Sulphuret of Lead P. b. S.
Analysis.....Lead and Sulphur.
Silver—none.
By R. C. HENNESSEY.

No. 4. GALENA, ———?
Sulphuret of Lead
Analysis.....Lead and Sulphur.
Silver—none.
H=2·5 cryst. I Cleavage on cube.
By R. C. HENNESSEY.

No. 5. ZINCITE. LITTLE LAWN.
Sulphuret of Iron Zinc, Cadmium.
Analysis.....Iron.
Zinc.
Cadmium.
Cryst. ½ I. H=3·5—4. Sp. G. 3·9—4·2.
By R. C. HENNESSEY.

No. 6. MORETON'S HARBOR ORES.
S.G., 4.5. Blende.
Galena.
Mundic.
Mispicel.
Manganese.
Sulphide.
By BARCLAY.

No. 7. MAGNETIC PYRITES

Sulphuret of Iron. (Fe. S.)

Analysis ..... Sulphur.
Iron.
Copper—none.
Silver—none.
Cobalt—none.
Nickel—none.

H.=4, Sp. G.=4·4, Cryst. IV., magnetic.

By R. C. HENNESSEY.

No. 8. IRON PYRITES.

Sulphuret of Iron.

Iron.
Sulphur.
Copper—none.
Silver—none.

Cryst. I., H=6·5, Sp. G.=5.

By R. C. HENNESSEY.

No. 9. ARSENICAL PYRITES.

Round Pond, Bay d'East River.

Sulphuret of Iron and Arsenuret of Iron.
Fe. S2 x Fe. As2.

No Nickel.
No. Cobalt.

By R. C. HENNESSEY.

No. 10. HEMATITE. TILT COVE.

Si O2 per cent.	.33
Fe2 O3	99.16
S	.17
P2 O5	99.66

By BARCLAY.

No. 11. COLUMBITE. LABRADOR.

Oxide of Columbium	76.85
Wolfram	.73
Oxide of Tin	1.20
Oxide of Iron	17.34
Oxide of Manganese	4.62=100.83

No. 12. VIVIANITE. HIRKEEN, ST. MARY'S BAY.

6 (P O5 Fe3 O3x3 H2 O) x P O5 Fe3 O3 x 8 H2O.)

Phosphate of Iron and Water.

Analysis ..... Phosphorus.
Iron.
Water.
Silver—none.
Copper—none.

Cryst.=V Sp G=2.66 H=1.5—2.

By R. C. HENNESSEY.

No. 13. CHROMIC IRON ORE. PIPESTONE POND.

(Fe O Mg O) Ch2 O3 Al2 O3.)
Chromate and Aluminate of Iron and Magnesia.
Analysis .....Iron.
Magnesia.
Chromium.
Alumina.
Cryst. I Sp G=4.3—45 H=55
Streak brown. By R. C. HENNESSEY,

No, 14. WHITE NICKEL ORE. TILT COVE.

As2 (Ni Co Fe.)
Arseniuret of Nickel, Cobalt, Iron.
Analysis .....Cobalt, 8—12 per cent.
Nickel, 28—32 per cent.
Cryst. cube H=55, G=6.9—7.
By R. C, HENNESSEY.

No, 15. (1) Gersdorfite (yellow) Tilt Cove.
(2) White Nickel Ore (blue).
(3) Copper Nickel (red).
(1) Nickel, Arsenic, and Sulpnur.
(2) Nickel, Cobalt, Iron, Arsenic.
Nickel, 28 per cent.—30 per cent.; Cobalt 10 per cent.—12 ner cent.
(3) Arsenic, Antimony, Nickel, Cobalt and Iron.
Nickel, 38 per cent.; Cobalt, 46 per cent.
. By R. C. HENNESSEY.

Analyses of Coal from three Seams, Bay St. George.

No. 16.	Cleary Seam.	Juke's Seam.	Howley Seam.
Water.....	3.548	3.036	2.784
Volatile Matter	30.897	30.344	29.271
Fixed Carbon..	55.229	60.142	54.468
Sulphur	3.946	1.963	3.047
Ash.....	6.380	4.515	10.430
	100.000	100.000	100.000

No. 17. Fireclay, From Coal Measures, Grand Lake.

Analysis:	(Silica)	$S_2 O_2$	81.86 per cent.
	(Iron and Alumina)	$Fe_2 Os$ & $Al_2 O_3$,	8.42
	(Lime)	Ca. O	0.31
	(Sulphur)	S	0.25
	(Combined moisture)	Combined $H_2 O$	9.00
			99.84

Arsenical Iron Pyrites. Bonavista Bay.

Silica.....	5.0
Iron	39.0
Arsenic.....	33.0
Copper.....	0.8
Lime.....	1.0
Sulphur.....	20.0
Silver.....	2.72 oz. to the ton.
Gold.....	a trace

Analyses of Coal Specimens from Grand Lake, or Central Carboniferous Area.

By Wm. H. Fitton, F.G.S., F.S.Sc., Mining Engineer, England.

Aldery Brook, Grand Lake.

Analysis No. I.	No. 20 Seam.
Moisture.....	7.41
Volatile Matter.....	30.73
Fixed Carbon.....	53.49
Ash.....	7.71
Sulphur.....	.66
	100,00

Coke (in closed vessel).....	61.86	per cent.
Colour of Ash.....		light pink.

ALDERY BROOK, GRAND LAKE.

Analysis No. II.	No. 15 Seam
Moisture	15.78
Volatile Matter	30.30
Fixed Carbon	45.29
Ash	8.08
Sulphur	.55
	100.00
Coke (in closed vessel)	53.92 per cent.
Colour of Ash	light grey.

ALDERY BROOK, GRAND LAKE.

Analysis No. III.	No. 16 Seam.
Moisture	5.82
Volatile Matter	33.62
Fixed Carbon	55.28
Ash	4.49
Sulphur	.79
	100.00
Coke (in closed vessel)	60.56 per cent.
Colour of Ash	brown.

ALDERY BROOK, GRAND LAKE.

Analysis No IV.	No. 6. Seam.
Moisture	5.80
Volatile Matter	31.44
Fixed Carbon	57.86
Ash	4.08
Sulphur	.82
	100.00
Coke (in closed vessel)	62.76 per cent.
Colour of Ash	light pink.

COAL BROOK, GRAND LAKE.

Analysis No. V.	No. 4 Seam.
Moisture	5.02
Volatile Matter	31.25
Fixed Carbon	54.03
Ash	8.66
Sulphur	1.04
	100.00
Coke (in closed vessel)	63.73 per cent.
Colour of Ash	light red.

ALDERY BROOK, GRAND LAKE.

Analysis No. VI.	No. 17 Seam.	
Moisture	4.32	
Volatile Matter	16.84	
Fixed Carbon	72.66	
Ash	5.33	
Sulphur	.85	
	100.00	
Coke (in closed vessel)	78.84	per cent.
Colour of Ash		light brown.

COAL BROOK, GRAND LAKE.

Analysis No. VII.	No- 3 Seam.	
Moisture	9.93	
Volatile Matter	24.01	
Fixed Carbon	49.15	
Ash	16.14	
Sulphur	.77	
	100.00	
Coke (in closed vessel)	66.06	per cent.
Colour of Ash		grey.

ALDERY BROOK, GRAND LAKE.

Analysis No. VIII.	No. 7 Seam.	
Moisture	10.77	
Volatile Matter.	16.55	
Fixed Carbon	33.89	
Ash	37.86	
Sulphur	.93	
	100.00	
Coke (in closed vessel)	72.68	per cent.
Colour of Ash		grey.

ALDERY BROOK, GRAND LAKE.

Analysis No. IX.	No. 2 Seam.	
Moisture	10.22	
Volatile Matter	24.39	
Fixed Carbon	48.51	
Ash	15.72	
Sulphur	1.16	
	100.00	
Coke (in closed vessel)	65.39	per cent.
Colour of Ash		light pink.

ALDERY BROOK, GRAND LAKE.

Analysis No. X.	No. 9 Seam.	
Moisture	13.71	
Volatile Matter	26.83	
Fixed Carbon	51.06	
Ash	7.56	
Sulphur	.84	
	100.00	
Coke (in closed vessel)	59.56	per cent.
Colour of Ash		light grey.

ALDERY BROOK, GRAND LAKE.

Analysis No. XI.	No. 23 Seam.	
Moisture	12.11	
Volatile Matter	19.53	
Fixed Carbon	44.70	
Ash	22.33	
Sulphur	1.33	
	100.00	
Coke (in closed vessel)	18.36	per cent.
Colour of Ash		grey.

LITTLE BROOK, GRAND LAKE.

Analysis No. XII.	No. 1 Seam.	
Moisture	8.44	
Volatile Matter	28.54	
Fixed Carbon	50.07	
Ash	11.53	
Sulphur	1.42	
	100.00	
Coke (in closed vessel)	63.92	per cent.
Colour of Ash		red.